National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Parkway
Houston, Texas 77058-3696

Reply to Attn of: EA3-10-005

TO: Alpha Magnetic Spectrometer (AMS) Records

FROM: EA3/NASA AMS Project Manager

SUBJECT: AMS Magnet Correlation Report

The AMS magnetic field was measured on December 21, 2009. The enclosed AMS Task Sheets (ATS) MITM091217-50 documents the measured data. The magnetic field was measured outside the magnet at 28 points. The points corresponded to a reasonable subset of external points measuring outward from the AMS origin in the X, Y and Z directions. The data was recorded with a F.W. Bell Model 4048 Gauss Probe. The instrument had a range of 0-20 kG with a resolution of 0.1 G. The magnet was charged to 400 Amps, which is the expected on-orbit operating current.

The model of the AMS magnetic field was used to predict the field level at the same locations. The model was set to correspond to the same 400 Amp charge on the magnet. The predictions were run by Vitaly Choutko, of the Massachusetts Institute of Technology, on Feb. 17, 2010.

A comparison of the measured versus predicted has been completed and is shown in the second enclosure.

The comparison shows that the model is an accurate prediction tool for the AMS magnetic field. The field measurements were root sum squared to take out any angularity bias in the measurement. Two measurements were taken at 1.5 meters from the center of the magnet. These points had the highest measurements and in both cases, the model predicted higher values than the actual magnet (9.9% and 4.2% higher). Four measurements were taken at 2.0 meters from the center of the magnet. These points represented the next highest field levels. These four points show that the model predictions were within 0%, 9%, 17%, and 7%. In all of these cases, the model predictions were higher than the actual measurements.

The measured data does show some small discrepancies in areas where it was either harder to get the probe to the exact location or where the structure of the AMS itself could have had a larger effect on the field measurement.

In summary, the AMS model predictions are an acceptable representation the actual measured magnetic field. The model can be used to predictions and magnetic field modeling and the results will accurately represent the actual system.

Sincerely,

Trent D. Martin

Enclosure

Enclosure 1: AMS Task Sheet – MITM091217-50

1. PROJECT CODE	2. JPIC CODE	AMS-02 TASK SHEET (ATS)
SA-AMS	AMS	

3. TYPE				4. ATS NO.	5. PAGE
A	CONFIGURATION CHANGE	☐		MITM091217-50	1 OF 7
	PERMANENT ☐ TEMPORARY	☐	6. MOD SHEET(S) NUMBER(S)		
B	NONCONFIGURATION CHANGE	☒			

10. PART NAME	11. Sub Detector Name	12. SERIAL/LOT NO.
AMS Cryomagnet	AMS Cryomagnet	

14. APPLICABLE DOCUMENTS

18. ATS TITLE
External Field Mapping of AMS

20. OPER SEQ. NO.	21. OPERATIONS (Print, Type, or Write Legibly)	VERIFICATION 22. TECH	23. QA/DV
	This ATS contains:		
	• **The Gauss data gathered during full field magnet mapping.**		
1.	**Open this ATS.**	RK	
2.	**Record the AMS Cryomagnet field strength (from CGSE data)**	RK	
	Cab Charge Amps 400		
	Hall Probe Gauss +x/-y/+z x component = 9400 G		
	+x/-y/-z x component = 9510 G		
	-x/-y/-z x component = 9430 G		
	-x/+y/-z x component = 9510 G		
3.	**Record the Model, range and resolution of the Gauss probe**	RK	
	Model F.W. Bell Model 4048 **Range** 0 – 20 kG **Resolution** 0.1 G		

24. ORIGINATOR	DATE	25. FINAL ACCEPTANCE STAMP AND DATE
John Heilig		

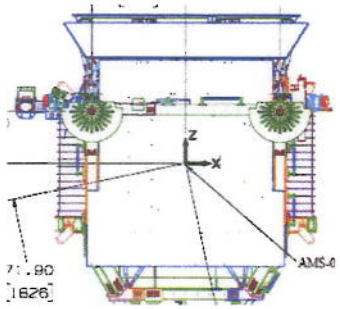
APPROVALS *(Printed or Typed and Signed)*

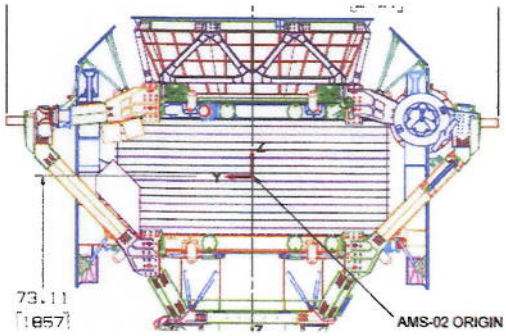
26. PROJECT ENGINEER	DATE	27. QUALITY ENGINEER	DATE
Joesph Burger J Burger	2/12/09	Corrado Gargiulo	
28.		29.	
30.		31.	

AMS-02 TASK SHEET (ATS)
CONTINUATION PAGE

4. ATS NO.	MITM091217-50
6. MOD NO.	

20. OPER SEQ. NO.	21. OPERATIONS (Print, Type, or Write Legibly)	VERIFICATION 22. TECH	23. QA/DV
4.	**Measure the external magnetic field around the AMS-02 Cryomagnet. Record the position in X,Y,Z from the center in AMS coordinate system. Record the Guass level in all three axis (x,y,z) at each point. Mark general position in the figures to follow and record data in table.**	RK	





Coordinate System of AMS

RK

Distance from Upper Support Ring to Lower Support Ring = 1470mm

Distance from Lower Support Ring to magnet origin = 735mm

Magnet origin to the floor = 1955mm

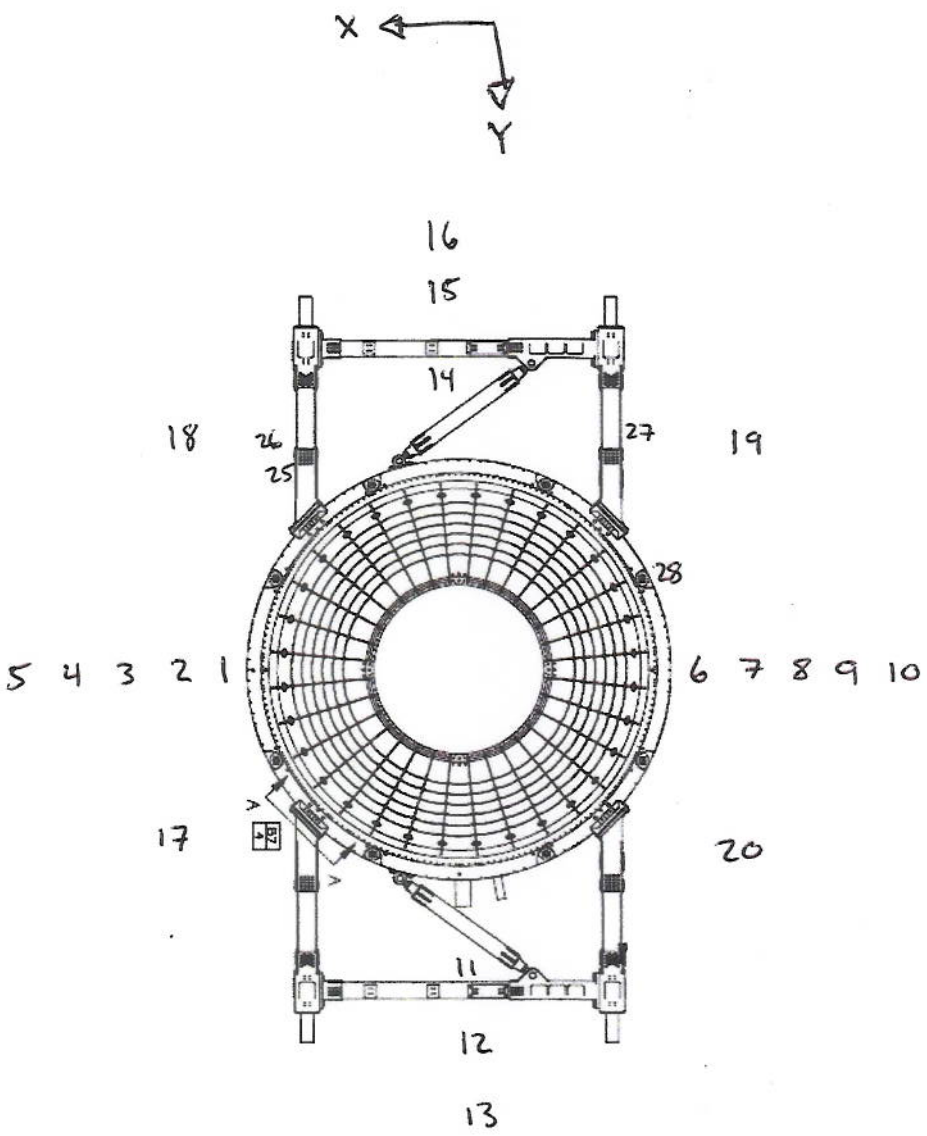
Diameter of Lower Support Ring = 2770mm

Radius from magnet origin to edge of Lower Support Ring = 1380mm

AMS-02 TASK SHEET (ATS)
CONTINUATION PAGE

4. ATS NO.	MITM091217-50
6. MOD NO.	

20. OPER SEQ. NO.	21. OPERATIONS (Print, Type, or Write Legibly)	VERIFICATION 22. TECH	VERIFICATION 23. QA/DV
		RK	



AMS-02 TASK SHEET (ATS)
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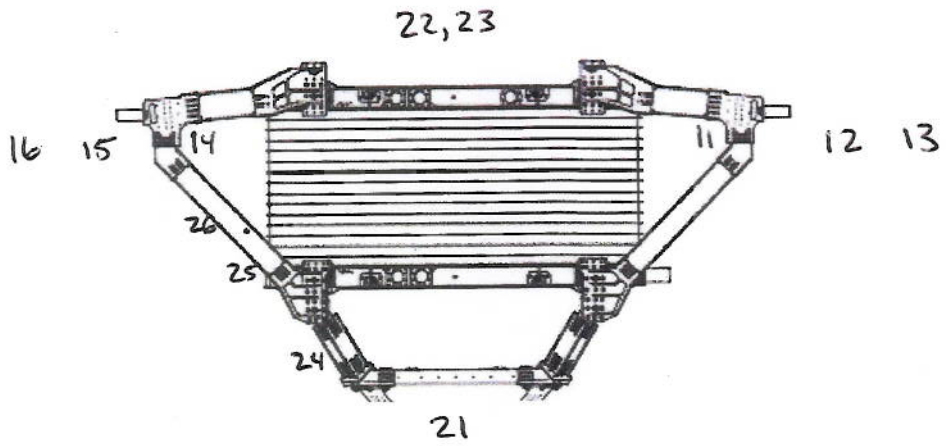
		RK	



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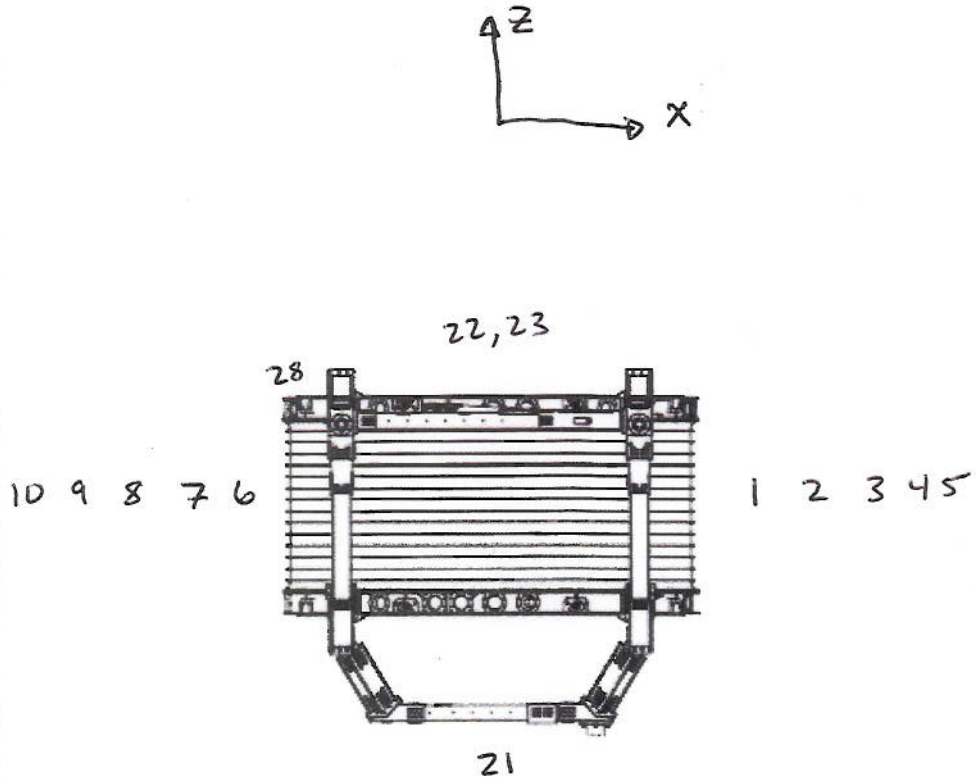
		RK	



AMS-02 TASK SHEET (ATS)
CONTINUATION PAGE

4. ATS NO. MITM091217-50

6. MOD NO.

20. OPER SEQ. NO.	21. OPERATIONS (Print, Type, or Write Legibly)	VERIFICATION 22. TECH	23. QA/DV

Pos	X (mm)	Y (mm)	Z (mm)	Bx Gauss	By Gauss	Bz Gauss
1	1500	0	0	-1025	-62.0	-112.3
2	2000	0	0	-255	15.9	48.0
3	2500	0	0	-81.8	10.4	6.1
4	3000	0	0	-32.4	-2.0	5.2
5	4000	0	0	-7.2	1.3	1.5
6	-1500	0	0	-1080	-64.6	-130.3
7	-2000	0	0	-233	-47.3	-16.0
8	-2500	0	0	-79.6	11.6	-7.2
9	-3000	0	0	-31.5	2.5	-1.3
10	-4000	0	0	-7.1	1.5	1.2
11	0	2000	0	-112.6	6.5	8.3
12	0	3000	0	14.9	1.5	0.4
13	0	4000	0	-4.7	1.0	0.1
14	0	-2000	0	-122.2	10.4	8.1
15	0	-3000	0	-15.2	0.5	0.8
16	0	-4000	0	-4.3	0.3	0.1
17	2000	2000	0	32.3	2.4	-1.6
18	2000	-2000	0	28.4	2.6	-1.5
19	-2000	2000	0	25.5	2.6	1.5
20	-2000	-2000	0	28.5	-2.9	1.5
21	0	0	-1750	-73.4	4.5	2.2

RK

AMS-02 TASK SHEET (ATS)
CONTINUATION PAGE

4. ATS NO. MITM091217-50

6. MOD NO.

20. OPER SEQ. NO.	21. OPERATIONS (Print, Type, or Write Legibly)	VERIFICATION 22. TECH	VERIFICATION 23. QA/DV

22	1000	0	2000	15.9	0.5	37.7	RK
23	-1000	0	2000	16.7	1.0	-26.2	
24	1000	-1000	-1250	69.4	-3.0	-145.8	
25	1000	-1250	-250	205.6	-98.5	-126.2	
26	1000	-2000	250	54.7	-91.8	3.3	
27	-1000	-2000	250	45.0	101.6	-14.3	
28	-1500	-1000	750	161.2	-137.4	57.7	

#24 – Lower USS hand rail

#25 - +X, -Y USS lower hand rail

#26 - +X, -Y USS upper hand rail

#27 - -X, -Y USS hand rail

#28 – Fill port

5. Close this ATS. RK

------ Forwarded Message
From: Vitaly Choutko <Vitaly.Choutko@cern.ch>
Date: Thu, 18 Feb 2010 04:37:17 -0600
To: Trent Martin <trent.d.martin@nasa.gov>
Subject: RE: Magnetic Field map

Hi Trent
please find attached the model predictions

Regards

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Point	X(mm)	Y(mm)	Z(mm)	Model Magnetic Field		
				Bx(G)	By(G)	Bz(G)
1	1500	0	0	1135.3	0	0
2	2000	0	0	260	0.1	0
3	2500	0	0	82.7	0.1	0
4	3000	0	0	32.5	0	0
5	4000	0	0	7.5	0	0
6	-1500	0	0	1135.1	-0.1	0
7	-2000	0	0	259.8	-0.1	0
8	-2500	0	0	82.7	-0.1	0
9	-3000	0	0	32.5	0	0
10	-4000	0	0	7.5	0	0
11	0	2000	0	133.2	0.4	0
12	0	3000	0	18.2	0	0
13	0	4000	0	4.4	0	0
14	0	-2000	0	132.4	-0.9	0
15	0	-3000	0	18	-0.1	0
16	0	-4000	0	4.3	0	0
17	2000	2000	0	-28.3	-0.1	0
18	2000	-2000	0	-28.1	0	0
19	-2000	2000	0	-28.2	0.1	0
20	-2000	-2000	0	-28	0.1	0
21	0	0	-1750	66.8	0	0
22	1000	0	2000	-13.8	0	-19
23	-1000	0	2000	-13.8	-0.1	19.3
24	1000	-1000	-1250	-80	8.3	94.7
25	1000	-1250	-250	-448.4	240	108
26	1000	-2000	250	-31.6	91.1	-17
27	-1000	-2000	250	-31.8	-90.6	17.1
28	-1500	-1000	750	-111.3	94	-16

Enclosure 3: Comparison of Model Predictions to Measured Data

Point	X(mm)	Y(mm)	Z(mm)	Model Magnetic Field			Measured Magnetic Field		
				Bx(G)	By(G)	Bz(G)	Bx(G)	By(G)	Bz(G)
1	1500	0	0	1135.3	0	0	-1025	-62	-112.3
2	2000	0	0	260	0.1	0	-255	15.9	48
3	2500	0	0	82.7	0.1	0	-81.8	10.4	6.1
4	3000	0	0	32.5	0	0	-32.4	-2	5.2
5	4000	0	0	7.5	0	0	-7.2	1.3	1.5
6	-1500	0	0	1135.1	-0.1	0	-1080	-64.6	-130.3
7	-2000	0	0	259.8	-0.1	0	-233	-47.3	-16
8	-2500	0	0	82.7	-0.1	0	-79.6	11.6	-7.2
9	-3000	0	0	32.5	0	0	-31.5	2.5	-1.3
10	-4000	0	0	7.5	0	0	-7.1	1.5	1.2
11	0	2000	0	133.2	0.4	0	-112.6	6.5	8.3
12	0	3000	0	18.2	0	0	14.9	1.5	0.4
13	0	4000	0	4.4	0	0	-4.7	1	0.1
14	0	-2000	0	132.4	-0.9	0	-122.2	10.4	8.1
15	0	-3000	0	18	-0.1	0	-15.2	0.5	0.8
16	0	-4000	0	4.3	0	0	-4.3	0.3	0.1
17	2000	2000	0	-28.3	-0.1	0	32.3	2.4	-1.6
18	2000	-2000	0	-28.1	0	0	28.4	2.6	-1.5
19	-2000	2000	0	-28.2	0.1	0	25.5	2.6	1.5
20	-2000	-2000	0	-28	0.1	0	28.5	-2.9	1.5
21	0	0	-1750	66.8	0	0	-73.4	4.5	2.2
22	1000	0	2000	-13.8	0	-19	15.9	0.5	37.7
23	-1000	0	2000	-13.8	-0.1	19.3	16.7	1	-26.2
24	1000	-1000	-1250	-80	8.3	94.7	69.4	-3	-145.8
25	1000	-1250	-250	-448.4	240	108	205.6	-98.5	-126.2
26	1000	-2000	250	-31.6	91.1	-17	54.7	-91.8	3.3
27	-1000	-2000	250	-31.8	-90.6	17.1	45	101.6	-14.3
28	-1500	-1000	750	-111.3	94	-16	161.2	-137	57.7

Point	X(mm)	Y(mm)	Z(mm)	RSS Model	RSS Measured	RSS Difference	% Difference
1	1500	0	0	1135	1033	102	9.9
2	2000	0	0	260	260	0	0.0
3	2500	0	0	83	83	0	0.0
4	3000	0	0	33	33	0	-1.1
5	4000	0	0	8	7	0	0.4
6	-1500	0	0	1135	1090	45	4.2
7	-2000	0	0	260	238	22	9.0
8	-2500	0	0	83	81	2	2.4
9	-3000	0	0	33	32	1	2.8
10	-4000	0	0	8	7	0	2.0
11	0	2000	0	133	113	20	17.8
12	0	3000	0	18	15	3	21.5
13	0	4000	0	4	5	0	-8.5
14	0	-2000	0	132	123	9	7.7
15	0	-3000	0	18	15	3	18.2
16	0	-4000	0	4	4	0	-0.3
17	2000	2000	0	28	32	-4	-12.7
18	2000	-2000	0	28	29	0	-1.6
19	-2000	2000	0	28	26	3	9.8
20	-2000	-2000	0	28	29	-1	-2.4
21	0	0	-1750	67	74	-7	-9.2
22	1000	0	2000	24	41	-17	-42.2
23	-1000	0	2000	24	31	-7	-23.7
24	1000	-1000	-1250	124	162	-37	-23.1
25	1000	-1250	-250	520	261	259	99.5
26	1000	-2000	250	98	107	-9	-8.4
27	-1000	-2000	250	98	112	-15	-12.9
28	-1500	-1000	750	147	220	-73	-33.2